UNIVERSITY OF JOHANNESBURG

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EM	
FM	

FACULTY OF SCIENCE

DEPARTMENT OF APPLIED PHYSICS AND ENGINEERING MATHEMATICS
NATIONAL DIPLOMA IN ENGINEERING:
COMPUTER SYSTEMS, *ELECTRICAL, MECHANICAL, MINERALS SURVEYING, CHEMICAL, INDUSTRIAL, MINING, METTALURGY, EXTRACTION METTALURGY, ANALYTICAL CHEMISTRY.*

MODULE MAT1AW1/FWWE112/MAT1YBU
ENGINEERING MATHEMATICS 1, MATHEMATICS 1 (EXT), APPLIED BUILDING SCIENCE

CAMPUS DFC

JUNE EXAMINATION

DATE 02/06/2014SESSION 12:30 – 15:30
ASSESSORS MS NTSIME BP
MR DLAMIN PG
INTERNAL MODERATOR MR MORAPELI EZ

DURATION 3 HOURS **MARKS 100**

SURNAME AND INITIALS:_____

STUDENT NUMBER:_____

COURSE:_____

LECTURER: _____

CONTACT NO: _____

NUMBER OF PAGES: 22

INSTRUCTIONS: ANSWER ALL THE QUESTIONS

REQUIREMENTS: INFORMATION BOOKLET
: NON-PROGRAMMABLE SCIENTIFIC CALCULATOR
: ANY WORK WRITTEN IN PENCIL WILL NOT BE MARKED

SECTION A[20]

INSTRUCTIONS

USE THE TABLE ON PAGE 4TO <u>MARK THE LETTER</u> (X) CORRESPONDING TO THE CORRECT ANSWER. DO YOUR ROUGH WORK ON THE BLANK PAGES.

1. If $f(x) = 2e^{3-x}$ then $f^{-1}(1)$ is equal to:

   A -3.69 B -6

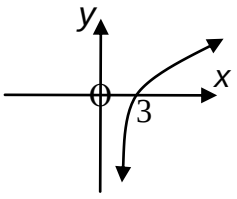
   C 3.69 D 1.25

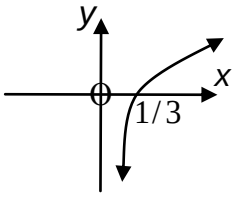
2. If $\log_{1/2}(x+3) = 3$, then x is equal to

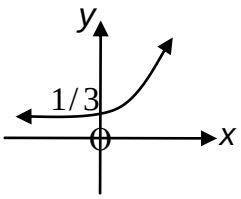
   A -2.94 B 5.58

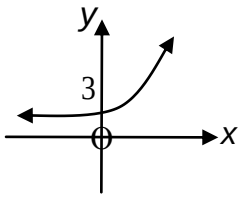
   C 462.01 D -2.88

3. The graph of $f(x) = 3^{x+1}$ is :

A 

B 

CD 



4. The value of $\sin(\ln \cot^{-1}(\sqrt{3}))$ is equal to:

   A -0.60 B -0.15

   C -0.012 D Undefined

5. $z = \left(-\frac{\sqrt{3}}{4} + \frac{\sqrt{3}}{4}j\right)^9$ is equal to:

   A $0.0086 - 0.0083j$ B $-0.0086 - 0.086j$

   C $0.0086 + 0.0086j$ D $-0.0083 + 0.0083j$

6. The fourth term in the binomial expansion of $\sqrt[3]{\frac{1}{x} - y}$ is equal to

A $-\frac{5}{81}\sqrt[3]{x^8}y^3$ B $\frac{5}{81}\sqrt[8]{x^3}y^3$

C $\frac{5}{81}\sqrt[3]{x^8}y^3$ D $-\frac{5}{81}\sqrt[8]{x^3}y^3$

7. The phase shift of the wave equation $y = 30\sin\left(3t + \pi^{\pi}\right)$, is:

A 3.29 units left B 3.29 units right

C 12.15 units left D 12.15 units right

8. The value for x given $\begin{vmatrix} e^x & 2 \\ \ln e & e \end{vmatrix} = 1$ is

A 2.099 B $\frac{\ln 3}{2}$

C 0.099 D undefined

9. Given that $y = \frac{t^2 - 1}{1 - t}$ then $\frac{dy}{dt}$ is equal to:

A $-t$ B -1

C t D $\frac{2t}{(1-t)^2}$

10. The integral $\int \frac{x}{(x^2+1)^3} dx$ is equal to:

A $\frac{1}{4(x^2+1)^2} + C$ B $\frac{-1}{4(x^2+1)^2} + C$

C $\frac{(x^2+1)^2}{4} + C$ D $\frac{-(x^2+1)^2}{4} + C$

1.	**A**	**B**	**C**	**D**	6.	**A**	**B**	**C**	**D**

2.	**A**	**B**	**C**	**D**	7.	**A**	**B**	**C**	**D**
3.	**A**	**B**	**C**	**D**	8.	**A**	**B**	**C**	**D**
4.	**A**	**B**	**C**	**D**	9.	**A**	**B**	**C**	**D**
5.	**A**	**B**	**C**	**D**	10.	**A**	**B**	**C**	**D**

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SECTION B[33]

INSTRUCTIONS

GIVE ONLY THE FINAL SIMPLIFIED ANSWER (CORRECT TO TWO DECIMAL PLACES WHERE APPLICABLE) IN THE SPACE PROVIDED. DO YOUR ROUGH WORK ON THE BLANK PAGES. ANY WORK WRITTEN ON PENCIL WILL NOT BE MARKED.

11. The rectangular form of $Z = e^{1-j}$ is (2)

12. Write down the first three terms in theBinomial expansion $\dfrac{-2}{\sqrt[3]{x-\dfrac{3}{x^2}}}$

(3)

13. The current in an AC circuit at any time t, measured in seconds, is given by the following equation:

$$i = 20\sin\left(5\pi t - e^2\right).$$

Find,

13.1 maximum current (1)

13.2 the period (1)

13.3 Sketch one cycle of the graph, showing all intercepts with the axes clearly. (4)

14. Solve for the unknown x in the following

14.1 $\cot^{-1}(2x) = \frac{\pi}{4}$ (1)

14.2 $2^{\frac{2}{\ln x}} = 3^{\log_3 8}$ (2)

15. Determine the following derivatives, in their simplest form.

15.1 $\frac{dy}{dx}$ if $y = e^{-\ln x}$ (1)

15.2 $\frac{dy}{dx}$ if $y = \cos^2 x$ (2)

16. Evaluate the following integrals:

16.1 $\int\left(\frac{-1}{t}\right)dt$ (2)

16.2 $\int \frac{x^2 + 2x + 7}{x^2 + 7}\, dx$ (2)

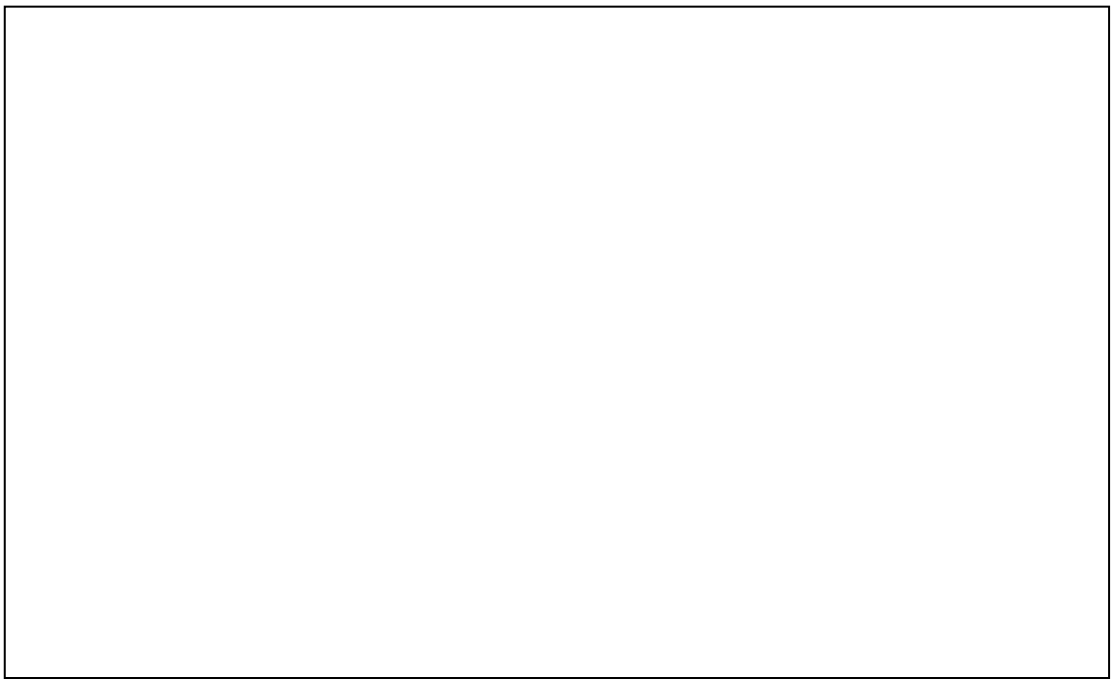
16.3 $\int (\cos k)\tan x \sec^2 x\, dx$ (1)

17. Make neat sketch graphs of the following. **Show intercepts with axes**, if any.

17.1 $x = y^2 + 5y + 4$ (4)

17.2 $y + \log_{\frac{1}{2}} 2x = 0$ (3)

17.3 $12x^2 - 16y^2 + 48 = 0$ (4)



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SECTION C[55]

INSTRUCTIONS

SHOW ALL THE STEPS TAKEN AND GIVE YOUR FINAL ANSWERS CORRECT TO TWO DECIMAL PLACES WHERE APPLICABLE. USE PAGE 22 TO RE-DO ANY QUESTION YOU MAY HAVE CANCELLED.

18. Use Cramer's rule to solve for y ***only****:* (5)

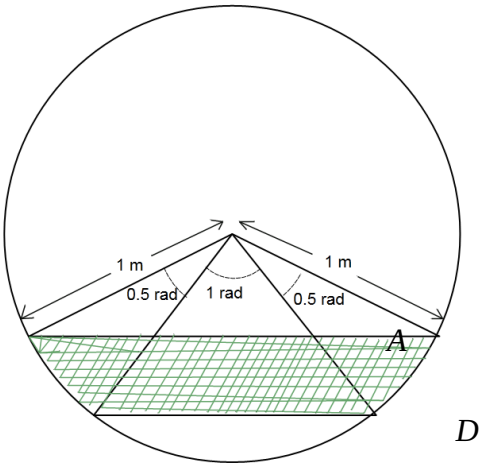
$$2x + 3y + 5z = 5$$
$$x + y = z$$
$$3y + x + 4z = 4$$

19. The resonant frequency f of an electric circuit is given by

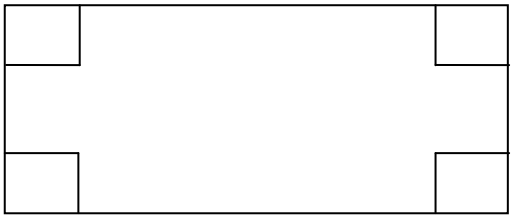
$f = \frac{1}{2\pi}\sqrt{\frac{1}{LC} - \frac{R^2}{L^2}}$.

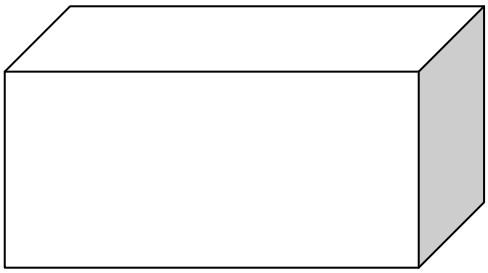
Make R^2 the subject of the formula. (4)

20. Consider the circle below. Calculate the area of the shaded region. (4)


1 m
1 m
0.5 rad
1 rad
0.5 rad
O
A
B
C
D

21. An open box is to be made from a $24cm$ by $16cm$ rectangular metal sheet. This is done by cutting a square from each corner of the sheet as shown below. Find the dimension of the box that will result in the maximum volume.





(5)

22. Solve the following equations for x :

22.1 $2\cos^2 x = -\sqrt{3}\cos x$ for $\pi \leq x < 2\pi$ (3)

22.2 $e^3 + e^{x+1} = e^{2x} + e^{x+2}$ (4)

22.3 $\ln^2(x+1) - 2\ln(x+1) = 3$ (4)

23. Find all the roots of z, ***in rectangular form***, that solve the equation: $z^3 + 3 + 2j = 0$. (5)

24. If $z_1 = 4 - 3j$ and $z_2 = \sqrt{3} + j$, use De Moivre's theorem to evaluate the following

$$\frac{(z_1)^4(\bar{z}_2)}{(z_2)^2} \qquad (4)$$

(Give your final answer in polar form).

25. Find the derivative of the following, giving your answer in its simplest form:

25.1 $\frac{dy}{dx}$ if $y = 3^{\sqrt{x}} + \sec^3 x$ (2)

25.2 $\frac{dy}{dx}$ if $y = (x^5 - 7)^3 . 7^{a+1} . \cos x$ (2)

25.3 $\frac{d^2y}{dx^2}$ if $y = \ln\sqrt{1-2x^3}$ (4)

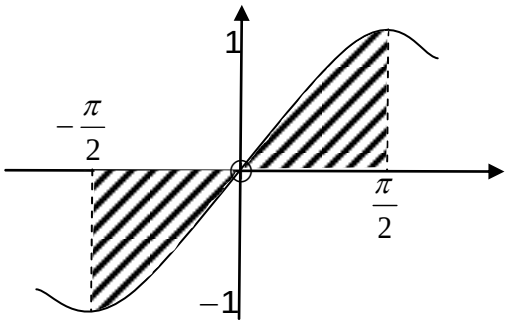
26. Determine the following integrals:

26.1 $\int_0^{\pi} \frac{e^{2x}+1}{e^x} dx$ (3)

26.2 $\int \frac{3x-6}{x^2-4x+8}\, dx$ (2)

26.3 $\int \frac{10^{\tan x}}{\cos^2 x}\, dx$ (2)

27. Calculate the area bounded by the graph of $y = \sin x$, the $x = -\frac{\pi}{2}$ and $x = \frac{\pi}{2}$ as shown in the graph below. (2)



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AVAILABLE MARKS: 108

USE THIS SPACE TO RE-DO ANY QUESTION YOU MAY HAVE CANCELLED